resulting in enormous waste and adding greatly to the cost of production.

The invention represented in this engraving is intended to obviate these objections by consuming the gases and products of combustion, generally, in the furnace where the iron is melted and puddled, and not in the chimney where no useful effect is gained from it.

Fig. 2 shows how this object is obtained. A grate, A, is provided at the end and a fire built upon it; from here the heat, smoke, and gases pass over into a larger chamber, B, where the iron to be melted is laid. The products of combustion, in passing over the bridge wall, C, are met by a blast of air which, together with the temperature gradually obtained in the chamber, results in much better combustion than usual. So great, in fact, that with the same kind of iron and coal used in this and in other furnaces, a saving of one-fourth the fuel is obtained and nearly forty per cent in ore for "fixing," yielding more iron of a better quality in a shorter time. The cost of this furnace is about the same as an ordinary one.

In order to facilitate the process of melting the pig and economize fuel as far as possible, the pig iron, before being put in the chamber where it is finally melted, is charged into a muffle, at D, which heats it very hot. From this it is subsequently removed, as before explained.

In the perspective view there is a trough, E, shown attached to the chimney. This is only a section of a length running across the building. The pipes, F] going from it enter water boshes, G, set about the jambs and sides of the furnace to prevent them from being burnt out. These water boshes are open at the ends, as shown at H, so that all danger from generating steam is obviated, the same being discharged into the open air instead of being confined, or, at best, so set as to require watchfulness, as is generally the case.

This furnace is now in successful operation at Montreal, C. E., and the wear and tear of brick work is far less than is common in the old plans.

The inventor is a practical puddler of many years' experience, and states that the furnace is adapted to the use of Western coal with blast, and an additional advantage is the construction of the water boshes. These are economical where "hot fixing" is used, as it generally is at the West. The engraving represents a double furnace, but it can be applied to a single one as well.

It was patented on the 3d of October, 1865, through the Scientific American Patent Agency, by John Williams. For further information address him at Victoria Iron Works, Montreal, C. E.

COUNTER-WEIGHTING MACHINERY.

The value of balance weights in all cases where rotating machinery runs at high speeds is so generally recognized in the present day that it may appear superfluous to add a word to the chapters which have already been written on the subject. Nevertheless there is hardly a question connected with their application in practice which does not still form a subject for discussion, and many mechanicians even now dispute the necessity for their use, fail to understand the principles on which their value depends, or apply them in such a way that they prove of little service. A short explanation of the theory of their action will therefore not be out of place here, and we shall endeavor to place the subject before our readers divested of those mathematical formulas for which practical men have so little liking. It is fortunate that the theory is so simple that this object may be easily carried out without detracting materially from the value of the explanation.

It is known that unbalanced machinery running at a high speed produces more or less violent oscillations in the supporting framework, which may be, and generally are, extended even to the buildings which contain it; and a little observation will show that these oscillations recur in a species of determinate sequence or rythm bearing a direct relation to the rapidity of revolution of the unbalanced machine. There is, in fact, nothing irregular about them. As the speed of the machine increases, so do they increase in number and intensity, and as their intensity increases in a more rapid ratio than the speed, they quickly become inconvenient, if not dangerous, representing as they do strains which waste power and seriously compromise the stability and permanence of machinery. It will also be understood that they have no connection with the strains properly due to the performance of useful work, and that they have existence in all unbalanced machinery, whether it does or does not run against a load. These oscillations are due, in short, to causes which have nothing whatever to do with the performance of the work which the machine is intended to execute, and there is but one way of removing, or, more properly, of preventing them. Their existence depends on the fact that "the whole centrifugal force of a body of any figure is the same in direction and amount as if the whole mass were concentrated at the center of gravity of the system," and that the centers of gravity and of rotation are not identical.

In order to make the meaning of this proposition perfectly clear, we may suppose the case of a fly-wheel accurately balanced, poised in space, and caused to revolve. The center of gravity of this wheel will be identical with its geometrical center, and it will therefore revolve about this last without displaying any tendency to assume another center of rotation. Let us now further suppose that certain weights are affixed at one side of its rim so that its accurate balance is destroyed, and that things being thus altered it is caused once more to revolve. The center of gravity no longer coincides with the geometrical center of the mass, but the wheel will only revolve about its center of gravity, and therefore that which was before the center of rotation now itself describes a circle whose radius will equal its distance from the new center of gravity. Thus, if the wheel have a diameter of 10 feet, and the weights added on are sufficient to shift the center of gravity 6 inches from the geometrical center, then will the circle described by this last have a diameter of 12 inches, and the wheel will then revolve eccentrically about the new center without developing any vibrating strains whatever. Why this law should have existence no one can pretend to say; we have only to do with the fact that it does exist, and that it is as immutable as the action of gravity itself.

We are now in a position to perceive why want of balance, or, strictly speaking, want of coincidence between the actual center of rotation and the center of gravity of any revolving mass, tends to produce oscillation. We have next to consider the magnitude of the disturbing force, We will suppose a fly-wheel in practice weighing 1,000 lbs., running at any given number of revolutions, and so far out of balance that its true center of gravity is distant 1 foot from its center of rotation. We purposely magnify the error in order to make the matter clear, and instances may be actually met with in which large fly-wheels are nearly a foot out of balance. The shaft being held down in brasses, it follows that the wheel is compelled to revolve about a center other than its center of gravity, and as a result of the tendency which we have seen to exist, the axis of the wheel, in endeavoring itself to describe a circle of 12 inches radius, strains the brasses and framing up and down to the right and to the left. But the framing is weaker in some directions than in others. In these it partially yields to the strains impressed upon it and withdrawn during each revolution, and the result is vibration. Thus, in the case of an unbalanced portable engine, it will be found that the entire structure rocks backward and forward at each stroke, as the shaft is thrust forward and backard in its endeavor to comply with the simple law which we have laid down. We said that the force of disturbance is the same as though the whole weight of the mass were concentrated at the center of gravity; and as in our case the weight is 1,000 lbs., and the radius one foot, the force of perturbation will be precisely the same in amount as if the entire wheel were suppressed and replaced by a single ball weighing 1,000 lbs. and rotating in a circle of 12 inches radius. With this fact before us it is easy to understand how great are the strains thrown on the bearings; and the heating and cutting of the brasses of unbalanced fly-wheels and crank shafts is no longer remarkable in any sense.

According to the theory commonly received by so-called practical men, it is sufficient to balance a crank and connecting rod by a weight or weights disposed within the fly-wheel rim, and this object is carried out with some elegance by forming the rim with recesses or cavities, so that it may be lighter on one side than the other. We shall not go so far as to say that such a practice is wholly erroneous, but we must impress upon our readers the fact that it is very imperfect. A steam engine so counterweighted is not in a strict sense counterweighted at all, and instances have come under our knowledge where recessing the fly-wheel rim has done more harm than good. The expedient would be perfect if the whole rotating mass were concentrated in the same plane, put in practical mechanical engineering this never occurs. Thus, in the case of an ordinary steam engine, we find that the crank and the fly-wheel are in all probability separated by a distance of several feet, and under such circumstances, counterweights applied to the latter cannot possibly compensate for the perturbations due to the gravitation of the former. The axis of the system then tends, at any given period of a revolution, to rotate about a point situated somewhere between the fly-wheel and the crank. Thus to deal once more in suppositions, let a shaft 10 feet long have at each end a fly-wheel similar to that of which we have already spoken, the center of gravity of each wheel being separated from the center of the shaft by a distance of 12 inches. It must further be assumed that the preponderating weights are so arranged as to be equal and opposite. If this shaft were now placed in bearings so that it could revolve freely, it would be found that the wheels would remain at rest in any position in which they might be placed, and from this it might be, and often is, assumed that the system would revolve at any speed without throwing a strain on the brasses. In short, the wheels would be deemed balanced in the full sense of the term. No idea can be more erroneous. If caused to revolve freely in space it would be found that each wheel would act almost independently of the other; the ends of the shaft describing, under the conditions, circles of 12 inches radius, while a point in the center of its length—and this point only—would remain unaffected. Its position may be determined by drawing a line from the center of gravity of one wheel to the center of gravity of the other, the point where this line cuts the axis of the shaft being the point of repose. From this it follows that the only proper method of balancing consists in disposing the counterweights in the same plane as the distributing force. In the strict sense this cannot possibly be accomplished in practice, but we can approximate to such a condition with sufficient accuracy to answer every reasonable purpose. The fly-wheel of an engine can of course be truly balanced with little trouble, but in order to balance the weight of the crank and connecting rod it is advisable to modify the former, converting it into a disk carrying the crank pin near its periphery at one side, while directly opposite a mass of metal must be provided sufficiently heavy to counterweight the proper proportion of the gravity of the connecting rod. Where this system is inapplicable, as in marine engines, the counterweights should be applied directly to the backs of the cranks—an arrangement carried out very perfectly by Messrs. Penn & Son. Each crank should be balanced as though none other existed in the length of the shaft, and the result is then, that, although neither of the weights is in the plane of the rod, yet as one comes on either side, an imaginary plane is constituted, in which the entire mass revolves in perfect balance. In paddle engines precisely the same arrangement should be adopted; a cast-iron paddle constituting a very imperfect substitute, which has sometimes lead to the breakage of a crank shaft, or even of the framing.

The calculation of the exact weight required as a counterbalance in any given case involves some points of considerable nicety; and hitherto the best results have been obtained under the system of trial and error. In point of fact, it is difficult to obtain all the data necessary to render the calculation perfectly complete; and the operation of increasing or reducing the weight of the counterpoises is so simple that no reasonable objection can be urged against a style of practice which is based on direct experiment. It is well, however, to know approximately what are the proper weights for any particular case; and as these are mainly determined by the centrifugal force of the mass to be balanced, the following simple rule for determining this factor will be of service to many who do not read formulas with ease:—Multiply the square of the number of revolutions per minute by the diameter of the circle of revolution in feet, and divide the product by the constant 5,870; the quotient is the centrifugal force of the body in parts of its weight, which is supposed to be 1. By this rule the strain on the shaft brasses may be easily determined; and the magnitude of the centrifugal force to be balanced having thus been found, it is a simple matter to determine with approximate accuracy the proportions proper for a counterweight usually revolving in a circle of greater diameter than that described by the crank pin.—*London Engineer.*

Maple Sugar Making.

Mr. A. S. Chapman, of New California, writes as follows to the *Rural New Yorker:*—

I will give you a short article on the making of maple sugar, as practiced in this region by the great makers—men who labor not for fun but for money—whose fathers and grandfathers made sugar here when moccasin tracks and red skins were too abundant for comfort. I will not burden you with a repetition of all the minute details of the business, but will merely give you an outline of their method.

There are some questions not yet settled among our manufacturers. For instance, a part maintain that a tree will last infinitely longer tapped with a gouge or ax than if tapped with a bit or auger, but the great majority use a half or five-eighth inch bit and the common elder spile or conductor. One old gentleman, some 76 years of age, avers that the trees last far longer to bore them.

All agree that well-burned two-gallon crocks are the best to catch the sap, being so easily cleansed—and as they turn them down at the foot of the tree and dispasture the land with sheep, they obviate the necessity of hauling them in and out as they would have to do with wooden or tin buckets.

Immediately after harvest they commence splitting up the old logs, the tops of oak trees and any refuse wood—no matter how rotted, if it will only split and hold together—to pile up or stand on end, and thus they continue to do at leisure times until snow comes, when it is hauled and stood on end at the camp-house.

For storage for sap they use hogsheads, or vats made of two-inch oak plank.

For boiling small kettles are used, holding from 13 to 17 gallons, and at the back of six kettles some place a pan to heat the sap or melt ice (particularly the latter, when they have it.) Sometimes a sudden freeze will come when the crocks are nearly full. If it only freezes over, they take a little forked stick, like an old fashioned pot-hook, break a hole with it through the ice and haul it out with the hook. If it freezes solid, they hit the edge of the crock against a root and out comes the ice in bulk, the saccharine matter preventing its freezing like common water.

One peculiarity of their furnaces is the distance from the bottom of the kettles to the bottom of the furnaces, which is about four feet. Thus it will be seen that while they use very small kettles, they make very great fires under them, and here lies the secret of making good sugar, viz., rapid evaporation in small vessels. The quicker it can be got off the fire without scorching the better. When it "leather aprons," or "makes roads," it is done. Great care is taken to keep the crocks sweet and the kettles clean. When the former get a little slippery or soured they are set out from the tree to catch rain water, and are then scrubbed out and turned down till the next run. When the kettles cannot be washed clean they are filled with hickory bark and burned out, which is far the best way of getting off the burned stuff from the top of them.

When the sirup is done, it is stored away in barrels or casks, until they have leisure and a fair day to sugar it, which is done in the same kettles where it was boiled into sirup. Should the sirup become ropy (sour), saleratus or soda is used to sweeten it.

In sugaring the tops of all the kettles are greased and a small piece of fat pork thrown into each with four or five gallons sirup and boiled with a light brisk fire until it will break in water, when it is dipped into wooden pails and emptied into long stirring-troughs, where it granulates and cools, and when the lumps are worked out it is put away for use or sale.

In conclusion I may say that too much care is not likely to be used to keep the kettles clean, that very rapid evaporation in small quantities (not much together) is necessary to make good sirup, and that insures good sugar.

A. S. CHAPMAN.

New California, Ohio, 1866.

Heating of Air by Compression.

SIR:—I observe that one of your correspondents wishes to know how to calculate the heating effect of compression on air. If the compression is but a small fraction of the original volume, the following rule may be near enough to the truth for most practical purposes:—Find the *absolute temperature* of the air by adding 461 to the temperature in Fah. degrees, or 274 to the temperature in Centigrade degrees; then multiply the absolute temperature by *two-fifths* of the fraction of its original volume, by which the volume of the air is diminished. The product will be the required increase of temperature. The fraction of itself by which the *pressure* is increased during the process is $=1{\cdot}4\times$ the fraction by which the volume is diminished.

Example.—Suppose original temperature to be 39 deg. Fah., then absolute temperature $=39$ deg. $+$ 461 deg. $=500$ deg. Fah. Suppose also the air to be compressed to 99-100ths of its original volume; then fraction expressing the compression $=0{\cdot}01$; consequently $0{\cdot}01\times\frac{2}{5}\times500=0{\cdot}004\times500=2$ deg. of Fah. elevation of temperature; also $0{\cdot}01\times1{\cdot}4=0{\cdot}014$, fraction of itself by which the pressure is increased.

When the compression is considerable, the calculation cannot be made with any approach to accuracy without the help of logarithms; and the following is the rule:—Take the logarithm of the ratio which the original volume of the air bears to the compressed volume; multiply that logarithm by 0·408; to the product add the logarithm of the original absolute temperature; the sum will be the logarithm of the new absolute temperature. Also multiply the logarithm of the ratio of the original to the compressed volume by 1·408; the product will be the logarithm of the ratio in which the pressure must be increased.

Example.—Suppose, as in the previous example, that the original absolute temperature is 500 deg. Fah.; suppose the air to be compressed to one-fourth of its original volume; then—

Log 4=	0.6020600
Multiply by	0·408
Product	0·2456405
Add log. 500 (original abs. temp.)	2·6989700
Log. 880·26 (new abs. temp.)	2.9446105

880·26 deg.—500 deg.=380·26 Fah., elevation of temperature; and 380·26+39=419·26, new temperature on Fah. ordinary scale. Also $0{\cdot}60206\times1{\cdot}408=0{\cdot}8477005=\log.\ 7{\cdot}0421$, ratio in which the pressure of the air is increased; so that if it is originally at atmospheric pressure, its new pressure is about seven atmospheres.

To find the mechanical work required in order to produce the compression (including that required for expelling the air from the pump) multiply the elevation of temperature, as computed by the preceding rules, by 0·238, and then by 772 if the temperature is expressed in Fah. deg., or by 1,390 if in Centrigrade deg.; the product will be the hight in feet to which the same quantity of work would lift a weight equal to that of the mass of air operated upon. That hight may be stated in other words as 183½ feet per deg. of Fah. or 330 feet per deg. Centrigrade. Thus, in the second example already given, we have 380·26 deg. Fah. for the elevation of temperature, and $380{\cdot}26\times138\frac{1}{2}=69{,}774$ feet, being the hight to which the mechanical work required, would lift a weight equal to the mass of air operated upon.

One lb. avoirdupois of air at the mean atmospheric pressure (14·7 lbs. on the square inch), and at the absolute temperature of melting ice (493 deg. Fah., or 274 deg. cent.), occupies 12·387 cubic feet; and at other pressures and temperatures its volume varies inversely as the pressure and directly as the *absolute* temperature. Divide the original volume of the air operated upon by the volume of 1 lb. at the original pressure and temperature; the quotient will be the weight operated upon in pounds.

It must be borne in mind that in order to realize the elevation of temperature given by the rules, the air must be perfectly dry; if liquid water is present, part of the heat developed takes effect in evaporating the water, and the elevation of temperature is much diminished.

W. J. MACQUORN RANKINE.

Glasgow University, 3d February, 1866.

[*Mechanics' Magazine.*

Mushroom Ketchup.

The latest public sensation in England in a small way is "Mushroom Ketchup." It seems that no mushrooms are used in the preparation of this delightful compound, but that the base of it is decayed beef liver, called Smithfield mushrooms. The London *Grocer* thus describes the process of manufacture:—

"This is how the crisp mushrooms of Smithfield are prepared for the delicate palates of the discriminating British public, who find poison in and forswear pickles, and lick their lips at the delicious juice of decayed animal matter. Enormous quantities of bullocks' livers—we beg pardon, Smithfield mushrooms—are collected in England, and imported in closed bags from the Continent. These are bought up by ketchup makers—not one or two known roughs, but men who are not generally known as publicans and sinners, and who have the confidence and, we may add, the cash, of the largest distributors of pickles and sauces in the United Kingdom. The mushrooms are salted in tubs, and allowed to remain until the mass becomes thoroughly putrid, and—the details are nasty, but we cannot, in justice to the anti-adulteration league, withhold them—the contents of the tubs are then boiled in iron tanks holding about one hundred and fifty gallons each. Each boiling occupies a whole night. It is never carried on by day, for the simple reason that the stench from the boilers would bring down the indignation of the neighbors, who inconsistently hold out one hand to the poor retailer for cheap luxuries, and with the other destroy the sources of their production. Copper tanks are never used for the boiling operation, for reasons that will be apparent to our readers. All that remains now is to strain off the liquid carefully, and add to its natural fragrance and pungency by mixing with it the spices of 'Araby the blest.' That which remains after the straining operation is immediately covered with a layer of ashes, and sold at convenience to manure dealers."

At a public meeting an attorney for the manufacture defended his client by denying that the livers were from bullocks; they were from hogs.

Have we any mushroom-ketchup makers among us?

American Cotton Stockings.

The Boston *Advertiser* says it has been a subject of frequent remark that improvements in American manufactures went on during the recent war at as rapid a pace as though the country were at peace. In no branch of industry has this advance been more apparent than in the manufacture of cotton hosiery in New England. Many millions of dollars are now invested in this business, and the competition with foreign manufacturers, which has become quite vigorous, is likely to be successful.

Until within eighteen months, the American manufacture has been confined to the common grade of ribbed hose, and no competition with England and Germany, in the manufacture of the finer qualities, has been attempted. Now, however, plain cotton hosiery of the best quality is extensively made by New England workmen, and no one need to seek for imported goods because of a scarcity of fine grades of American manufacture. These remarks will apply as well to the manufacture of cotton shirts, which has reached a great degree of perfection; and American shirts, full fashioned, and without seams, are now made equal to the imported.

The Lawrence Manufacturing Company, at Lowell, have entered largely into this branch of domestic industry, and now manufacture about a thousand dozen of the articles above named per day. A large portion of the labor is done by machinery; but much of it is given out as piece work, to be done outside the manufactory by persons who cannot leave their homes, and thus affords support to many who would otherwise find difficulty in obtaining employment. In this respect the business resembles the shoe manufacture more than any other branch of employment.

Method of Ventilating Ships.

In these engravings we have illustrated a new plan for effecting perfect ventilation, and for obtaining at the same time a stronger and better vessel than commonly built.

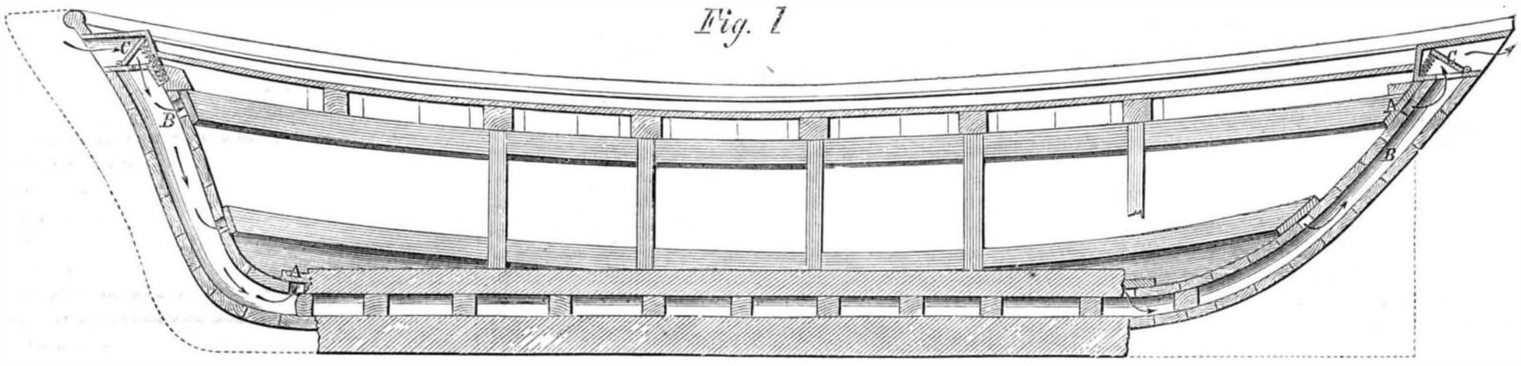

Fig. 1

WELLS'S METHOD OF VENTILATING SHIPS.

Channels are made at intervals, as at A, by a peculiar arrangement of the timbers and of the planks and ceiling. These communicate with an air passage, B. The latter is open at the bow, and has a valve, C, fitted to it, opening outward. This valve is always open under ordinary circumstances, being kept so by a spiral spring. When a heavy sea strikes it, however, it closes so as to prevent water from getting in.

The air enters this valve, and flowing down the air passage, B, finds its way to the channels cut through the timbers, in the manner shown by the engraving. Even if water should be in the bottom of the ship there are always channels open above to effect ventilation.

The space between the planking and the ceiling is divided by water-tight partitions above and below the decks, as shown in Figs. 2 and 3. These permit the spaces to be filled with brine to preserve the timber, if necessary, and they tend more particularly to prevent the ship from being loaded with water in case the external planking is broken.

It is claimed that vessels so constructed—that is, with an inner and outer skin, ventilated in the manner described, and prevented from being overloaded with water—are safer, more durable, and less expensive in point of repair than ships of the ordinary construction.

In order to make this plan of constructing a vessel understood, it may be well to say, first, that timber begins to decay at the center of the heart, and the decay goes on more or less rapidly as its situation is more or less exposed, until it reaches the surface. In order to prevent this decay, it must have constant, active ventilation, or else the atmosphere must be entirely expelled from it, as in the case of the keel of a vessel, or timber in other situations—when the absence of air is consequent upon the presence of water, and where the timber under such circumstances is found to be perfect after the lapse of centuries. Either of the above plans can be used separate from the other, or they may be used together, or changed from one to the other without inconvenience, or much expense. Suppose, for example, we commence the construction of a single-deck vessel, 100 feet in length on the keel, 27 feet wide, and 8 feet deep, we side the timber for this frame 10 inches, molding it 10 inches in the throat, and 6 inches at the upper edge of the deck clamp, allowing 20 inches of timber for 24 inches of timber room. This will require 48 square frames, and 4 forward and 3 after cants.

By this arrangement it will be seen that the average space between the two skins or between the out-board planking and the in-board planking, commencing at the upper edge of the deck clamp on one side, round by the bottom of the vessel to the upper edge of the deck clamp on the other side, is 8 inches, and the whole inner surface between the two skins is, if it could be spread out on one flat surface, equal to 100 feet in length by 40 feet in width, and, as before stated, 8 inches in thickness. This space is equal in bulk to 32,000 feet of inch boards, or 67 tuns cubic measure. Into this space the frame proper is to be put, and as we put 20 inches of timber in 24 inches of timber room, we claim five-sixths of this entire space for the frame proper; and five-sixths of 67 tuns is 56 tuns for the frame, leaving 11 tuns, or 440 cubic feet of space not occupied by the frame, to be filled with air or brine, as may best suit the views of the owner. The timber should be first thoroughly soaked or charged with the strong brine, applied before the vessel leaves the stocks, this being much the cheapest and most effective plan of salting the vessel, as by this course every cubic inch of the entire frame and every pore in it, is charged with the strong brine with which this space of 440 cubic feet is filled. The space between the timbers on top is filled in with chocks, so as to make the timber round the entire top solid; each joint being stop-watered so as to give a caulking seam at the upper edge of the deck clamps, and the out-board seam, which is on a line with the top of the deck clamps. This completes the air-tight arrangement between the two skins.

Next in importance is the plan by which active ventilation is at all times kept up. Supposing that most of the brine, which has previously filled the space between the timbers be pumped off, and the air let in to take its place. Air passages, or avenues, B, run the entire length of the vessel, and are carried out-board at the bow and stern by pipes made of boiler iron. These pipes are attached to each end of each opening, forward and aft. The openings are guarded by light valves C, as represented, which close when struck by a sea, are made on the under side of the thick streaks of ceiling past the frames by taking out of the under edge or corner of the thick streak, a score of 3 inches in depth and 4 inches in width, and when these two thick streaks of ceiling are put together they form an opening of 3 by 8 inches. A half dozen of these openings on a side will at all times give active currents of air passing through the entire frame, the pipes at each end being at all times open, and from which no possible damage can be apprehended, any more than from the cast-iron pipes forward, through which the chains pass. The sides of a ship, with two or more decks, is to be protected in the same way, by being made air-tight between the between-deck water-ways, and the between-deck clamps, in the same way as before described in the single deck vessel.

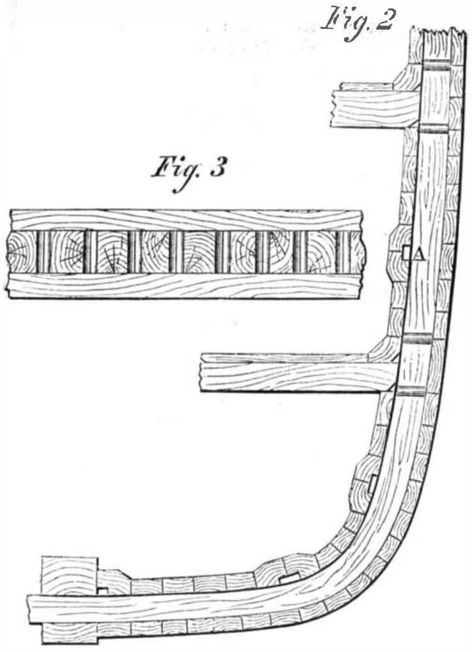

Fig. 2

Fig. 3

It is believed that this plan of construction and ventilation would be invaluable to the navy as well as to vessels in the merchant service, and the extra cost over the usual plan of building, in the vessels whose dimensions have been before stated, would not exceed five hundred dollars, and in that proportion for a larger or smaller vessel. And here it may with truth be said, that the extra strength of the vessel would more than twice pay the extra cost, saying nothing about the extra durability and the double safety in having two skins in place of one, so that if a plank should be stripped off the out-board, the in-board planking would protect the lives and property on board. This plan further offers a very cheap and reliable way of testing the perfection and tightness of the work before the vessel leaves the stocks. By inserting a three-quarter inch coupling in the out-board or in-board planking, and attaching a three quarter inch lead pipe to it, and elevating the other end of the pipe say 53 feet, and filling it with water; in this way a pressure of 25 pounds to the square inch is brought to bear on each square inch of the entire inner surface of both skins, or on the vessel whose dimensions have been before stated, where the inner surface of the two skins is 8,000 feet, the entire pressure would be equal to 28,800,000 pounds, or 14,400 tuns. This pressure would rapidly force the brine into every pore of the timber, and the salt required to make the brine to fill the before-mentioned 440 cubic feet not filled by the frame, would not exceed 86 bushels; the brine being as strong as salt would dissolve in water—as one gallon of Turk's Island salt will make 4 gallons of brine of this description. In removing the brine a small portion of it should be left on the dead flat of the floor to operate as a motive power to expel the air first from one side then from the other, as the ship rolls to either side, the air is forced out on that side, while the surrounding atmosphere rushes in to fill the space for the elevated side, and in this way a change of air from the outside is constantly kept up in every part of the ship's frame.

A patent was procured on it Dec. 12, 1865, by Oliver D. Wells, of Westerly, R. I. For further information address Oliver D. Wells as above.

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A Collapsed Cylinder Boiler.

Mr. Longridge, engineer to the Manchester Boiler Assurance Company, in his annual report, describes a very unusual accident, which occurred on the 30th October, at a bleachworks in the neighborhood of Bury, and, though not an explosion, it deserves notice. The boiler referred to was 30 feet long by 8 feet 5 inches diameter, made of plates varying from $\frac{5}{16}$ inches to $\frac{3}{8}$ inches in thickness, and had two internal flues 3 feet 2 inches diameter, made of $\frac{3}{8}$ inch plates. The ends were straightened by two longitudinal stays $1\frac{3}{4}$ inches square, secured by straps and cotters, and there was a similar stay above the flues across the boiler near the middle. The boiler was insured to work at a pressure not exceeding 8 lbs. per square inch, and was provided with a safety valve $4\frac{1}{2}$ inches diameter, loaded accordingly. It had also a steam pressure gage and glass tube water gage. About half past ten o'clock in the forenoon of the day mentioned the shell of the boiler collapsed on the right hand side, commencing about 3 feet from the front end, and fracturing through the line of rivets of the fifth circular seam, the collapse extending thence to the back end. The under side of the boiler was also forced upward about 2 inches for a length of 8 feet.

It appears that at the time of the accident there were no fires in the furnaces of this boiler, which was merely used as a steam reservoir, in communication with a range of pipes conveying the exhaust steam from some small high-pressure engines to the drying cylinders and bleaching kiers. There was, however, also a connection with five other boilers, working at a pressure of 50 lbs. per square inch, by means of a self-acting equilibrium valve, so arranged as to supply steam at a pressure of 8 lbs. per square inch, in case of need. Shortly before the accident, the attendant observing steam blowing off from the safety valve of the low-pressure boiler (the pressure indicated by the gage being then about 9 lbs.), went to the equilibrium valve and moved the weight on the lever, in order to reduce the supply of steam, and was returning to the fire place when the shell of the boiler collapsed, as already described, accompanied by a noise resembling that of distant thunder.

It appears that the valves communicating with two or three of the bleaching kiers had just been opened, which by causing a rapid condensation of steam, must have produced a partial vacuum in the pipes and low-pressure boiler, and thus caused the collapse, an accident which could not have occurred had there been a vacuum valve upon the boiler. Although this is the first instance of collapse of the shell of a boiler which has come under his notice, Mr. Longridge has no doubt that other boilers of large diameter made of light plates may at times become strained in the seams from the same cause; and as this can be so easily obviated by the attachment of an air valve, it seems advisable to apply one in such cases.—*London Engineer.*

FOREIGN SUMMARY.

It is estimated that 18,000 elephants are yearly killed to supply Sheffield alone with ivory.

Pouillet pointed out in 1822, that when a fluid is absorbed by a porus substance, a rise in temperature takes place.

The attractive force of a magnet being 150 pounds when free from disturbance, fell to one-half by causing an armature to revolve near its poles.

A magnet, the lifting force of which was 220 pounds when the armature was in contact, sustained 90·6 pounds when the armature was $\frac{1}{250}$ inches distant, and 40·5 pounds when $\frac{1}{50}$ inches distance. Thus at 1-50th of an inch distance $\frac{4}{5}$ of the power are lost.

In 1852 the *Wave Queen*, on iron vessel, was launched by Messrs. Robinson, Russel & Co., at Milwall. She was 200 feet long, and only 13 feet wide; engines of 80 horse-power; and she went to Denmark and back more than once. This is possibly the narrowest ship, for the length, ever built.

The cost of wax for sealing patents in 1864 is put down at £157 ! As the seals weigh upward of two pounds each, could not a saving be effected in this item? There is an officer of state called " Chaff-wax;" has he any connection with the patent department?

The ancient conduits about Jerusalem are of wonderful structure. One, the lower level conduit, formed of stone, follows the contour of the country for twenty-five miles, passing along the bend of a depression in one case of 55 feet depth, and entering the city at an altitude of 2,450 feet. The other, the upper level conduit, is tunneled through a hill at one part, and the blocks are so keyed together as to form a complete siphon.

NEW PUBLICATIONS.

Woodward's Country Homes.—Those who contemplate building country houses and do not wish to consult an architect, can find a great variety of designs to select from in this little volume. Hints on localities and choice of materials, selections of sites, etc., are given so that all tastes are likely to be suited.

The Horticulturist.—No magazine devoted to rural affairs is more welcome to our table than this one. It is not only clear in its descriptions of new plants, fruit, etc., but has an additional value in its illustrations. These are varied in character and relate chiefly to plans for country houses, new fruits, ornamental gardening, insect destructive to vegetation, etc. The several articles are entertaining and without pretension to display.

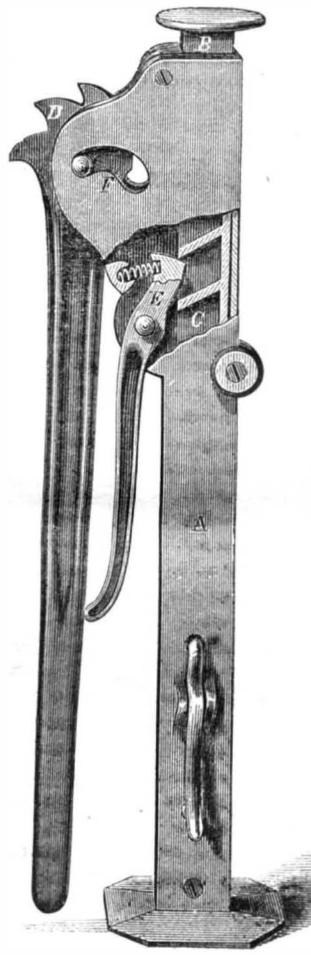
Both published by Geo. E. & F. W. Woodward, No. 37 Park Row, N. Y.

M. Carey Lea, of Philadelphia, one of the most prolific and best writers upon current photographic subjects, has just brought out a very useful edition of Newman's little manual on a harmonious coloring as applied to photographs. The book contains valuable information upon the best modes of lighting and posing the sitter, with a chapter on the production of harmonious negatives. Messrs. Benerman & Wilson, Philadelphia, are the publishers.

WOODWORTH'S CARRIAGE JACK.

A great many people in the world are contented to waste time with "make shifts" to do their work with, when, by a little outlay, they could procure approved tools designed expressly for the purpose, which would effect a great saving. We, and doubtless many of our readers, have seen men washing wagon wheels, greasing axles, and doing other work appertaining to them with the vehicle propped up on saw horses, on rails and similar defective arrangements, being twice as long about it as they would if they had proper appliances; such as a jack, for instance.

The engraving published herewith illustrates a convenient utensil of this class which is extensively used in some parts of the country. It consists, in detail, of a light but strong casting, A, having a bar, B, with ratchet spaces, C, cast in the same, working freely up and down inside of it. Attached to the top is a lever, D, having projections which work in these spaces, and below there is a pawl, E, which abuts against the teeth, and prevents the sliding bar from receding or slipping back. The long lever, D, does not work on a fixed center, but the same slides in a slot, F, so that the lever can be shipped into gear with the ratchet teeth when the axle is to be raised, and then withdrawn again and allowed to hang suspended, so that it is not in the way. The pawl, E, always takes the weight of the wagon so that it cannot fall, and it may be thrown out of connection with the sliding bar, by simply pressing on the end; this permits the wagon to be lowered steadily.



A spiral spring is placed at the bottom of the case for the bar to rest on so that it cannot jam the fingers of the person using it when handling it.

It was patented Dec. 5, 1865, by Albert Woodworth, of North White Creek, N. Y. Address him at that place for further information. State rights for sale.

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There are 3,089 miles of railroads in New York State, 962 engines, and capital invested $84,816,200,

The Association for the Prevention of Boiler Explosions.

At the monthly meeting of this Association, held at the office, Coporation street, Manchester, on Jan. 30th, Mr. William Fairbairn, C. E. (President), in the Chair, Mr. L. E. Fletcher, Chief Engineer, in his report said that, during the last month 252 engines have been examined, and 388 boilers, as well as one of the latter tested by hydraulic pressure. Of the boiler examinations, 274 have been external, five internal, and 109 entire. In the boilers examined, 103 defects have been discovered, 8 of those defects being dangerous. Another case of furnace crowns being injured through over heating has been met with, which would have been prevented by the adoption of the self-acting feed back-pressure valve, and by the feed inlet being fixed above the level of the furnace crowns. Since this subject has been already gone into, we need only to point out that the present is an additional case of injury which would have been prevented by the adoption of the above precautions; and, therefore, affords an additional argument for attention to them. A most important case of external corrosion took place at the bottom of a boiler set on a midfeather, and immediately where in contact with the brickwork. The extent of the injury, as is frequently the case, could not be seen until the brickwork was removed; and, therefore, it is trusted that those members whose boilers are set on midfeather walls will not omit, in preparation for flue examinations, to have the brickwork plowed out where the transverse seams of the boilers rest upon, so that the condition of the plates may be actually seen by our inspectors. Explosions this year are following one another in quick succession, and if they continue at the same rate, the annual list will be a long one. Already, since Jan. 1, six explosions have taken place, one of them of a very disastrous character, eight persons being injured, four of them fatally. The total return for the month up to Jan. 26 is six persons killed and seven others injured. Not one of the boilers in question was under the charge of this association.

An explosion, to which reference may be made, is one of those that will constantly recur so long as steam users continue boilers in work with ill-shaped furnace tubes, and persist in the neglect of the simple precaution of having these tubes strengthened with encircling hoops, flanged seams, or by other suitable means. This explosion took place at a mine. The boiler, which was not under the charge of this association, was of the Cornish class, having a single furnace tube, and being internally fired. Its length was 28 feet, and its diameter in the shell five feet nine inches. The diameter of the furnace tube is not so easily given, since it was of the most irregular shape. At the front end it measured four feet vertically by three feet nine inches horizontally. Midway in its length these proportions were reversed, its height being three feet nine inches, and its width four feet, while at the back end it measured three feet eight inches vertically, and three feet ten inches horizontally. There was not any part of the tube within at least one inch of the true circle, while there were other places more than four inches out of shape. The thickness of the plates was about 3-8ths in. to 7-16ths inch, while the pressure of the steam at the time of the explosion is reported not to have exceeded 20 lbs. per square inch. The furnace tube collapsed from end to end, but it was at the middle of its length, where its width had exceeding its hight by three inches, that the collapse appeared to have commenced, and where the greatest amount of depression took place, the top and bottom of the tube at that part being almost crushed together. It appears that this boiler had nearly collapsed on a previous occasion, when it was repaired, and the furnace tube left in the distorted and thoroughly unsafe state described above. The fact of boiler-makers executing their work in this way, and being entirely ignorant of the danger that must result from it, clearly shows the importance of competent periodical inspection; while this explosion is only another of those, already so numerous, that would have been prevented by the adoption of encircling hoops, flanged seams, water pockets, or water tubes, attention to which although so frequently called in previous reports, it is felt to be a duty again earnestly to urge, even at the risk of tedious repetition.